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Ram for a Stuffing Tool Used for Pressing a Strip-Shaped
Holding Element into a Borehole in a Toothbrush Head that
Accommodates a Bristle Cluster

The invention pertains to a ram for a stuffing tool according to the preamble of Claim 1 that is used for pressing a strip-shaped holding element into a borehole in a toothbrush head that accommodates a bristle cluster.

A ram for a stuffing tool according to the preamble of Claim 1 is already known from DE 195 28 762 C1. According to Figures 1, 5 and 9, this ram 30 has a rectangular cross section, the thickness of which essentially corresponds to the individual force-fitting surfaces of the vertically packed staples 20 according to Figures 1 and 5 that are generally referred to as holding elements or anchors in the remainder of the description. In Figure 9, a ram 30 severs the anchors 20 from a metal strip 22 that extends perpendicular to the longitudinal axis A of the ram 30. The longitudinal axis A of the ram 30 extends parallel to the center lines of the bores 14 in the toothbrush head 12, i.e., when a borehole 14 is stuffed with a bristle cluster 16, its center axis is aligned with the longitudinal axis A of the ram 30. The pressing surface of the ram 30 is referred to as the end face 32 in Figure 5. The ram 30 has wider longitudinal sides and narrower face sides that form a rectangle and the cross section of which essentially corresponds, according to Figure 5, to the cross section of the holding elements 20.

According to Figures 1 and 5, a bristle cluster 16 extends perpendicular to the longitudinal axis A of the ram 30, wherein this bristle cluster is subsequently pressed into a borehole 14 and deformed into the shape of a U while being pressed into the borehole 14. Although not illustrated in the figures, the lateral edges of the holding element 20 actually cut into the edge of the borehole 14 in the brush

head 12 during this process. The ram 30 presses the holding element 20 into the edge material of a borehole 14 in the brush head 12 until the anchor 20 no longer protrudes from the surface of the brush head 12. The slot--not illustrated in the figures--produced in the borehole wall by the anchor 20 while it is pressed into the borehole presses against the edges of the longitudinal sides of the anchor with such intensity that the anchor 20 is rigidly fixed in the brush head and the bristle cluster 16 is immovably anchored in the borehole 14.

EP 1 088 495 A also discloses a ram 12 for a stuffing tool 6 according to the preamble of Claim 1 that is used for driving a strip-shaped holding element 5, 22 into a borehole 3 that accommodates a bristle cluster 2. According to Figure 1, a thin metal wire 10 extending perpendicular to the ram 12 is inserted into the stuffing tool 6. The free end of the wire 10 perpendicularly protrudes into the channel 11 guiding the ram 12. When the ram 12 is displaced in the direction of the toothbrush 4, it shears off a section of wire 10 that is then transported in the direction of the toothbrush head 4 along the channel 11 and ultimately forms the holding element 5, 22. During the displacement of the ram, the holding element 5 according to Figure 2 collects a bristle cluster 12 consisting of numerous filaments 16, wherein the holding element 5 centrally deforms the bristle cluster into the shape of a U. The bristle cluster 12 is then pressed into a borehole in the toothbrush together with the anchor 5 in this fashion. The holding element 5 is pressed into the borehole 3 until it is no longer accessible from outside and the free end of the bristle cluster 2 protrudes from the borehole by a predetermined distance. According to Figures 4 and 7, the end face regions of the holding element 5 carve into the wall of the borehole 3 such that grooves (no reference symbol) are formed. Due to the elastic material of the brush head 4, these grooves firmly press against the

lateral faces of the holding element 5 and thusly hold the holding element 5 in the borehole 3. The bristle cluster 2 can be reliably anchored in the borehole 3 in this fashion.

In modern toothbrushes, the bores frequently are no longer aligned with the longitudinal axis of the ram, i.e., the bores are inclined relative to this longitudinal axis such that the bristle clusters do not perpendicularly protrude from the surface of the toothbrush head, but rather with a certain incline. Practical experience showed, however, that this frequently leads to damages to the pressing surfaces or to the end of the ram breaking off. This is associated with significant installation and repair expenditures because the ram needs to be removed from the stuffing tool, trimmed and contoured anew. In addition, this also leads to significant production losses because no toothbrush heads can be stuffed during these repair procedures.

Consequently, the invention is based on the objective of improving a ram of the initially described type in such a way that its service life is not only extended when it is used in connection with bores that are aligned with the longitudinal axis of the ram, but also bores that are inclined relative to the longitudinal axis of the ram, wherein this ram is also not subject to a premature fractures or other damages. The invention also aims to realize the ram such that the holding elements or anchors can be neatly and precisely pressed into the boreholes in order to reliably hold the bristle clusters in the boreholes.

According to the invention, this objective is attained with the characteristics disclosed in the characterizing portion of Claim 1. The pressing surface of the ram is enlarged and the moment of resistance as well as the moment of bending of the ram is increased in that the cross section of the ram is outwardly widened in the central region of its

lateral faces. The enlarged pressing surface ensures that the holding element or anchor is also taken hold of by the enlarged ram surface if it attempts to slightly slide away laterally while it is pressed into the borehole. This means that the anchor can be neatly pressed into the brush head. Due to its increased moment of resistance, the ram is able to withstand higher loads while the holding element is pressed into the brush head, namely even in the presence of possible lateral loads. This means that the ram does not fracture prematurely. The enlarged pressing surface of the ram has the advantageous effect of largely preventing the "sliding effect" and therefore the risk of fracturing the ram, namely even in instances in which the end face of the holding element is typically rounded. The same effect is also achieved when pressing partition walls into boreholes because these partition walls are pressed into the boreholes in accordance with the same principle. Partition walls are used for dividing an oblong or oval borehole into several borehole sections and stuffing each partial borehole.

The thickening and stabilizing of the ram in the region of the borehole allows a superior guidance of the anchoring wires--independently of the borehole incline or the rounding of the anchoring wire. The number of ram fractures can be significantly reduced. In addition, the width of the gap or cut in the edge of the borehole (penetrating region of the anchor) also is defined by the width of the anchor only and not by the shape of the ram. In this case, the ram cross section is only noticeably widened in the region that penetrates into the borehole--but not into the borehole wall. The bristle extraction forces are not changed in comparison with conventional stuffing methods because the brush head is subjected to an analogous mechanical deformation by the holding element or anchor, respectively.

If one would forgo the widening of the ram cross section and instead widen the anchors, the edges of the borehole would be damaged more significantly when the anchors are pressed in due to the higher compressive forces. When using thicker anchoring wires, it would also be conceivable to stuff a significantly smaller number of bristles into a brush head with identical borehole geometry. However, this would result in increased wear of the bristles when the toothbrush is used. For example, if the borehole has a diameter of 1.5 mm, the number of bristles would be reduced by 5.1 % if anchors with a width of 0.25 mm are used rather than anchors with a width of 0.2 mm. The invention also makes it possible to prevent these disadvantages.

The characteristics disclosed in Claim 2 serve for additionally diminishing the stableness [sic] of the ram as well as the "sliding effect" of the anchor. Naturally, the thickening of the lateral faces cannot exceed the diameter of a borehole because the thickening of the ram would otherwise carve into and damage the edge of the borehole when a holding element is pressed in. The thickening on the pressing surface of the ram consequently is limited to the area of the borehole. According to the characteristics disclosed in Claim 3, the cross section of the pressing surface of the ram can also be increased by providing a thickening on one lateral face of the ram only.

The ram can be manufactured in a particularly simple fashion if its cross-sectional widening is realized in the form of a step (Claim 4). This makes it possible to achieve the greatest increase in cross section possible behind the region that no longer penetrates into the material of the brush head. According to the characteristics disclosed in Claims 5-7, the cross section may be widened in a rectangular fashion (Claim 5), a trapezoidal fashion (Claim 6) or in the shape of a pitch circle (Claim 7). In this respect, it is advantageous that the corner radii are as

large as possible in order to maintain the notch stress on the ram as low as possible. The corners can be subsequently machined into the sintered hard metal sheet by means of milling, grinding or the like. According to the characteristics of Claim 8, it would also be conceivable, however, to realize the ram in the form a rolled profile sheet that was hardened and tempered in order to achieve the required strength.

According to the characteristics disclosed in Claim 9, the pressing end of the ram is realized in the shape of a wedge. This prevents the plastic area from being cut more significantly than usual, namely because the bristle extraction forces would otherwise be reduced and the height of the protruding bristles would be increased. When using a pressing surface with a size of 1.1 mm in order to the press an anchor into a borehole with a diameter of 1.5 mm to a minimum depth of 0.85 mm, this means that the point needs to be angled by no less than 75°. If the borehole has a diameter of 1.7 mm, the size of the pressing surface is increased by 0.2 mm, wherein the minimum angle is maintained at 75° in this case (Claim 10).

According to the characteristics of Claim 11, the size of the pressing surface exceeds the size of the holding element surface acted upon by the ram by approximately 10-40 %, preferably 25 %. These dimensions make it possible to realize a particularly stable ram that has a significantly longer service life than conventional rams.

According to the characteristics disclosed in Claim 12, the brush head preferably consists of an injection-molded plastic part. The ram according to the invention is particularly advantageous for manufacturing toothbrushes in which a particularly large number of boreholes needs to be stuffed with bristle clusters, namely because a significantly longer service life of the ram can be

achieved in this case. However, the pressed-in bristles may also form part of a brush, a broom, a paintbrush or a similar tool comprising bristles (Claim 13).

One embodiment of the invention is illustrated in the figures and described in greater detail below. The figures show:

Figure 1, an enlarged top view of the pressing surface of a ram according to the invention;

Figure 2, an enlarged top view of a ram pressing surface that is slightly modified in comparison with Figure 1;

Figure 3, a ram in the form of an enlarged side view in the direction X, and

Figure 4, an enlarged top view of an additionally modified ram pressing surface.

It should be initially noted that the device for pressing a holding element into a borehole in a brush head by means of a ram is known from and described in detail in publications DE 195 28 762 C1 and EP 1 088 495 A1. This is the reason why another description of this device appears unnecessary at this point. The characteristics disclosed in both applications are hereby incorporated into the present application by reference.

The following description pertains to the innovative design of the ram 1 only. This ram is illustrated in the form of a view from the pressing surface 2 in Figures 1, 2 and 4. In Figure 3, the ram 1 is sectionally illustrated in the form of a side view in the direction X according to Figure 4. The longitudinal axis A of the ram 1 according to Figure 3 corresponds to the longitudinal axis that is shown in Figures 1, 5 and 9 of publication DE 195 28 762 C1 and

identified by the same reference symbol, i.e., the ram 1 according to Figure 3 extends vertically upward while its pressing surface 2 lies perpendicular to the plane of projection.

In Figures 1, 2 and 4, the pressing surface 2 extends in the plane of projection. The ram 1 according to the invention can also be utilized in stuffing machines known from the state of the art. In this case, it is merely required to adapt the lateral profiles of the slots in the stuffing tool for accommodating the ram 1 to the newly designed ram 1.

In Figures 1, 2 and 4, the pressing surface 2 is defined by one longitudinal side 3 and face sides 6 of identical length extending perpendicular thereto, wherein the fourth side consists of the projecting area 16 that is formed by the narrower face side 7 and the narrower longitudinal side 4 in Figure 1, of the projecting area 18 and the two triangular projecting areas 20 on both corner regions 17 in Figure 2, and of the projecting area 19, the size of which corresponds to that of the projecting areas 16 and 18, respectively, as well as the two rectangular projecting areas 21 on both corner regions 17 in Figure 4. The triangular projecting area 20 according to Figure 2 is formed by the face side 8 that extends transversely upward and the face sides 30, 31 that lie perpendicular to one another. The rectangular projecting area 21 according to Figure 4 is formed by the perpendicularly extending face sides 10 and the horizontally extending lateral faces 32. The longitudinal sides 3 extend parallel to the longitudinal sides 4, 15; 5; 33. The narrower face sides 7 extend perpendicular to the longitudinal sides 3, 4 in Figure 1.

In Figure 1, the longitudinal side 3 has the length a and the narrower longitudinal side 4 has the length b. In

Figure 2, the longitudinal side 3 has the length a and the narrower longitudinal side 5 has the length b. According to Figures 1 and 2, the face sides 6 and the longitudinal side 3 form a rectangular surface, wherein the imaginary longitudinal sides 11, 12 that lie opposite of lower longitudinal side 3 are drawn with broken lines in the figures. On the upper side 13 shown in Figure 1, a step 14 is arranged on both sides at a distance $\frac{a-b}{2}$, wherein said steps extend perpendicular to the longitudinal side 3 and consequently parallel to the face sides 6. The short longitudinal sides 15 with the lengths $\frac{a-b}{2}$ extend parallel to the longitudinal side 3 in Figure 1. The projecting area 17 formed by the longitudinal sides 15 and the face sides 6 is the area that penetrates into the wall of the borehole when a (not-shown) holding element is pressed in, namely analogous to the corresponding areas shown in Figures 4 and 7 of EP 1 088 495 A1. According to the aforementioned EP publication, the remaining area covered by the width b would penetrate into a borehole and therefore be in contact with the wall of the borehole.

According to Figure 1, the area defined by the face side 7 and the shorter longitudinal side 15 represents the projecting area 16 of the ram 1 according to the invention. This projecting area 16 is larger than pressing surfaces known from the state of the art that usually have the dimensions $a \cdot d$ only. In Figure 2, the pressing surface 2 including the projecting area 18 is increased in comparison with the pressing surface 2 including the projecting area 16 according to Figure 1 by the triangular surface 20. In this case, the narrow face side 8 preferably extends at an angle γ of approximately $8 \pm 2^\circ$.

The area that extends beyond the length b and forms the end face region 17 of the ram 1 in Figures 1, 2 and 4 is the

area that--according to the aforementioned EP--penetrates into the borehole wall of a brush head and presses the holding element into the borehole to such a degree that it no longer protrudes from the brush head surface on the bristle side after the ram is retracted from the borehole. In Figure 1, the cross-sectional area 24, 25, 26 between the end face regions 17 of the ram 1 penetrating into the borehole is wider than the end face regions 17 on the face sides by the projecting area 16.

A comparison between the narrow face side 8 according to Figure 2 and the narrow face side 15 according to Figure 1 makes it clear that the penetration of the ram 1 shown in Figure 2 causes more brush head material to be displaced than the penetration of the ram 1 shown in Figure 1. The most material is displaced with the ram 1 shown in Figure 4, namely because the narrower face side 10 in the form of a rectangle is superimposed on the face side 6 and this end face region 21 is situated directly adjacent to the face side 6. The projecting areas 19 according to Figure 4 with the corresponding end face regions 21 define the largest cross-sectional area, i.e., this ram 1 has the highest flexural rigidity. The ram according to Figure 2 has a slightly lower flexural rigidity than the ram 1 shown in Figure 4, and the ram 1 shown in Figure 1 has the lowest flexural rigidity in comparison with the rams 1 shown in Figures 2 and 4, namely because it does not contain any projecting areas in its end face regions 17. In contrast to the ram 1 shown in Figure 2, the ram 1 shown in Figure 1 does not displace any material on the borehole wall when it is pressed into a borehole, wherein the material displacement in comparison with the former ram is doubled when the ram 1 shown in Figure 4 is pressed into a borehole. The reason for this can be seen in that the projecting areas 21 of the end face regions 17 are nearly twice as large as the projecting areas 20 of the end face regions 17 in Figure 2.

According to Figures 1 and 2, the width d preferably is about 0.2 mm if the borehole has a diameter of approximately 1.5 mm, wherein the ram has a length a of about 2 mm and a length b of about 1 mm. The overall lengths c and f on the respective face sides 6, 7 and 8 are about 0.25 mm, and the length d on the face side 6 is about 0.2 mm. In Figure 4, the length a of the lateral face 3 is also about 2 mm and the length f is about 0.25 mm. If the boreholes have a larger diameter, the corresponding parameters are increased in accordance with the rule of proportion.

In Figure 3, the longitudinal surfaces 22 situated adjacent to the longitudinal sides 3 on both opposite sides as well as the face sides 23 situated adjacent to the top of the end face regions 17 on both opposite sides form the outer surfaces of the ram 1. The face sides 23 are beveled outward at the end face regions 17 by an angle e of 75°. This simplifies the penetration of the ram 1 into a borehole in the brush head because the surface of the end face regions 17 gradually increases as the ram penetrates into the material. The end face regions 17 according to Figure 3 consequently form a wedge-like surface such that the penetrating resistance only increases gradually and damages to the ram and to the toothbrush head are prevented.